

PATENT ABSTRACTS OF JAPAN

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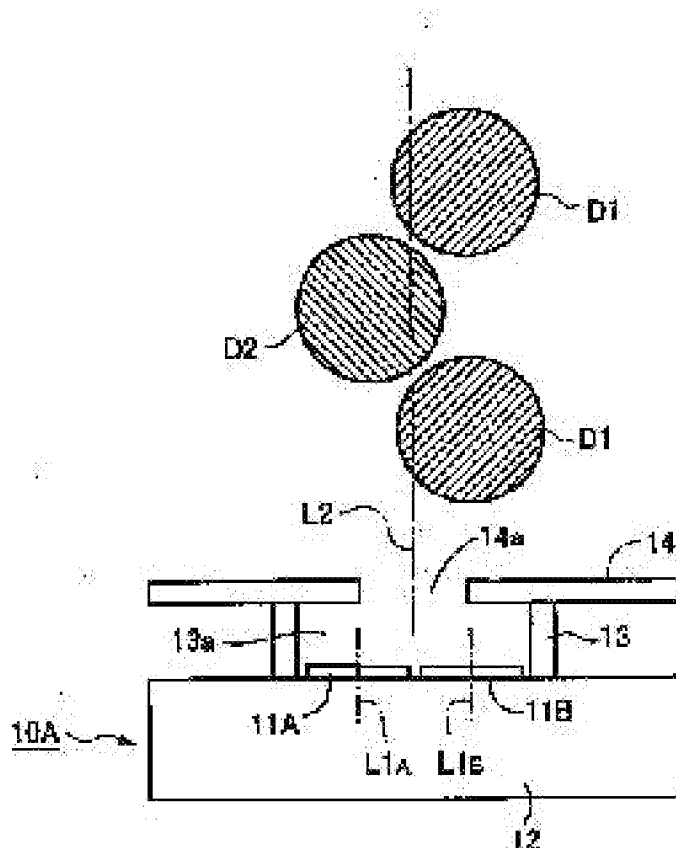
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(54) PRINTER HEAD, PRINTER AND METHOD FOR DRIVING PRINTER HEAD

(57)Abstract:

PROBLEM TO BE SOLVED: To make a deviation of a impact position unnoticeable in a line head of a thermal ink jet printer.

SOLUTION: In the printer, an ink liquid drop D1 or D2 is discharged from a nozzle 14a by driving a heater 11A or 11B, and is made to impact on a printing object body which shifts relatively to the nozzle 14a, whereby an image is recorded. The printer head used in the printer has a plurality of heaters 11A and 11B set for one nozzle 14a to different positions in an ink chamber 13a corresponding to one nozzle 14a. The plurality of heaters 11A and 11B can drive independently of each other.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to the drive method of a printer provided with the printer head for making not conspicuous the stripe by impact position gap of an ink drop, and its printer head, and a printer head in a thermal ink jet line printer.

[0002]

[Description of the Prior Art]The serial head and the line head are known as a printer head of the conventional thermal ink jet printer. A serial head carrying out the both-way drive of the head horizontally, and performing the print of a line direction, it carries out prescribed distance displacement of the paper (delivery), and performs the print of a succeeding line. A line head is a thing so that a nozzle may be arranged in a line direction and the print of the one line can be carried out at once. After carrying out the print of the one line at once, prescribed distance displacement of the paper is carried out, and the print of a succeeding line is performed again.

[0003]Drawing 5 is a sectional view showing an example of the ink discharge part of this conventional kind of printer head. In the ink discharge part 10, the heater 11 for heating an ink drop is formed on the silicon substrate 12.

The drive is controlled by a predetermined drive circuit.

On this silicon substrate 12, the resin film 13 which carried out the opening of the heater 11 and its peripheral part is formed.

[0004]Of the section structure of the opening part of this resin film 13, the liquid ink room 13a which has the heater 11 is formed. The resin sheet 14 is laminated on the resin film 13. The nozzle 14a by which the opening was carried out to the circle configuration is formed in the resin sheet 14. And the heater 11 and the resin sheet 14 are relatively arranged so that the center line L1 of the heater 11 and the center line L2 of the nozzle 14a may be in agreement.

[0005]In drawing 5, although only the one ink discharge part 10 is illustrated, two or more ink discharge parts 10 are installed in one way (printing line direction) by approximately linear shape side by side. That is, the heater 11 is arranged in on the silicon substrate 12 with a prescribed interval, and the nozzle 14a is located in a line, and is formed so that it may correspond to each heater 11.

[0006]The liquid ink led to the ink passage (not shown) from the ink tank (not shown) is guided at the liquid ink room 13a, and is heated with the heater 11 in this liquid ink room 13a. And an ink drop is

made to breathe out from the nozzle 14a by the energy at the time of this heating. A picture is recorded on dot form by ink drop D which reached the body for a print.

[0007]

[Problem(s) to be Solved by the Invention]However, in the above-mentioned Prior art, the grade of gap with the center line L1 of the heater 11 and the center line L2 of the nozzle 14a becomes a problem. In a manufacturing process, since various errors arise, the center line L1 of the heater 11 and the center line L2 of the nozzle 14a are not necessarily in agreement strictly. By this gap, since the orbit of breathed-out ink drop D shifts from the center line L2 of the nozzle 14a, it becomes impact position gap of ink drop D, and it appears. This impact position gap is based on existence of the garbage adhering to the position shift of the heater 11 and the nozzle 14a by the pasting error at the time of sticking the resin sheet 14 on the silicon substrate 12 and the nozzle 14a, or the angle gap to the deviation from circular form and the perpendicular direction of an opening diameter of the nozzle 14a.

[0008]Drawing 6 (a) and (b) is a figure explaining impact position gap of ink drop D by gap with the center line L1 of the heater 11 and the center line L2 of the nozzle 14a. As shown in drawing 6 (a), to the center line L1 of the heater 11, only in X, the center line L2 of the nozzle 14a shall have shifted (the amount X of gaps), and the angle gap theta shall arise into the regurgitation orbit of ink drop D by this.

[0009]In drawing 6 (a), while the target position of an impact position is made into ink drop D' and a two-dot chain line part shows when the amount X of gaps is 0 and the angle gap theta of the regurgitation orbit of ink drop D is 0 namely, the solid line shows the impact position of ink drop D in case the amount X of gaps and the angle gap theta actually exist.

[0010]Drawing 6 (b) makes a table the amount X of gaps, and a relation with the angle gap theta. In drawing 6 (b), it shifted to the horizontal axis, the quantity X (micrometer) was taken, and the angle gap theta (deg) is taken along the vertical axis. As for drawing 6 (b), the outer diameter of the nozzle 14a shows the value when the outside of 17 micrometers and the heater 11 sets applied power of the heater 11 to 500 mW, the repetition frequency of 1.2 kHz, and pulse 1.5micro S in width using 18 micrometers x 18 micrometers, and a water-based ink.

[0011]From the actual measurement, it was set to angle gap $\theta = 0.0029X - 0.4878$, and the result with $\theta/X = 0.21 \text{ deg}/\mu\text{m}$ was obtained. Therefore, under the above-mentioned conditions, when the center line L1 of the heater 11 and 1 micrometer of center lines L2 of the nozzle 14a shift, the angle gap theta of 0.21 (deg) will arise.

[0012]And when distance from the position (discharge position of ink drop D) of the heater 11 to the impact side of the body for a print is set to R, the impact position of ink drop D will shift from the target position of an impact position only $R \times \tan \theta$ by the angle gap theta.

[0013]This impact position gap does not become a problem in particular when the amount X of gaps of the center line L1 of the heater 11 and the center line L2 of the nozzle 14a is small. However, when the amount of gaps became large, there was a problem of having become a stripe and appearing, at the time of image recording.

[0014]Here, in a serial head, even if it is a case where the angle gap theta exists in the discharging angle of the specific nozzle 14a, impact position gap of ink drop D is seldom conspicuous. That is, in being a serial head, even if impact position gap of ink drop D arises, ink drop D reaches the neighborhood field by the regurgitation from other nozzles 14a. Therefore, when the whole picture by which the print was carried out is seen, impact position gap becomes difficult to be conspicuous.

[0015]On the other hand, in a line head, if impact position gap of ink drop D has arisen on the line in order to carry out the print of the one line at once with one head, even after the impact position gap displaces the body for a print, it will be generated in the same position on one line. When this looks at the whole picture by which the print was carried out, there is a problem that impact position gap will be conspicuous in the shape of a stripe.

[0016]Drawing 7 is a figure showing an example which carried out the print using the line head. A longitudinal direction is the side-by-side installation direction of the ink discharge part 10 among a figure, and a sliding direction is a displacement direction of the body for a print. In drawing 7, it counted from the left and the impact position of the 4th ink drop D4 has shifted leftward among the figure from the target position. Counting from the left, the impact position of the 5th ink drop D5 has shifted rightward among the figure from the target position. Thus, in the case of a line head, it has characteristic impact position gap for every head. In the example of drawing 7, the interval of the 4th and the 5th impact position becomes larger than other intervals. As a result, since in the case of a line head this characteristic will be dragged as it is and a print will be carried out, as shown in drawing 7, it becomes a stripe of a color lighter than a peripheral part between the ink drops D4 and D5, and it appears.

[0017]Counting from the left in this case furthermore, the interval of an impact position with the 3rd and each 4th ink drops D3 and D4 becomes narrower than other intervals. Therefore, it becomes a stripe of a color deeper than a peripheral part between the ink drops D3 and D4, and it appears.

[0018]The art indicated by JP,10-235854,A is known as a method of solving impact position gap of breathed-out ink drop D. This art is vibrating a line head to the main manipulating direction of a line head, or carrying out specified quantity movement, and makes impact position gap not conspicuous.

[0019]However, in this method, there is a problem that it is required to move a line head to the main manipulating direction with high precision, and a mechanism becomes complicated. Since generating of the noise accompanying movement of a line head can be considered, there is a problem of it becoming impossible to employ efficiently the silence which is an original merit of a line head.

[0020]Therefore, the issue which this invention tends to solve is making impact position gap not conspicuous in the line head of a thermal ink jet printer.

[0021]

[Means for Solving the Problem]This invention solves an above-mentioned technical problem by the following solving means. In a printer head used with a printer which an invention of claim 1 drives [printer] a heater, makes an ink drop breathe [printer] out from a nozzle, makes an ink drop reach the body for a print relatively displaced to said nozzle, and records a picture, Said heater of plurality which can be driven was individually formed in a different position of the liquid ink interior of a room corresponding to said one nozzle to said one nozzle. An invention of claim 2 installed said two or more nozzles in approximately linear shape side by side in the printer head according to claim 1.

[0022]An invention of claim 3 is a printer provided with the printer head according to claim 1. As for an invention of claim 4, in the printer according to claim 3, said at least two heaters are installed in abbreviated rectangular directions side by side to a displacement direction of the body for a print among said two or more heaters.

[0023]An invention of claim 5 is a drive method of a printer head used with the printer according to claim 3, While driving 1 or the 1st two or more heaters among said two or more heaters formed corresponding to said one nozzle and making an ink drop breathe out, Different 1 or the 2nd two or more heaters from said 1st heater are driven, and an ink drop is made to breathe out after displacement of

prescribed distance of the body for a print.

[0024] Said heater of any 1 among said two or more heaters which an invention of claim 6 is a drive method of a printer head used with the printer according to claim 3, and were formed in said one nozzle, Said two or more heaters are simultaneously driven so that driving force of said other heaters of 1 may differ.

[0025] Since two or more heaters which can be driven are individually arranged to one nozzle in this invention at a different position of the liquid ink interior of a room corresponding to one nozzle, By changing a heater which should be driven for every line among two or more heaters, making an ink drop breathe out or changing driving force of two or more heaters, even if it is the same nozzle, a discharging angle of an ink drop is changeable. Therefore, an impact position to the body for a print of an ink drop is changeable. It becomes possible to make not conspicuous impact position gap peculiar to a nozzle by this.

[0026]

[Embodiment of the Invention] Hereafter, one embodiment of this invention is described with reference to drawings etc. Drawing 1 is a sectional view showing one embodiment of the ink discharge part of the printer head by this invention. In drawing 1, identical codes are given to the same portion as drawing 5, and the overlapping explanation is omitted suitably. Like drawing 5, although only the one ink discharge part 10A is shown, in drawing 1, similarly, two or more ink discharge parts 10A are formed in a printing line direction along with approximately linear shape, and constitute the line head of a thermal ink jet printer from drawing 1.

[0027] While feeding the bodies for a print, such as a paper, to a printer and displacing only prescribed distance relatively to the nozzle 14a in a print, After the print, the transportation roller which pinches and conveys, predetermined delivery mechanism, for example, body for a print, for delivering paper, the actuator which drives the transportation roller, the control section which controls the drive of an actuator, etc. are provided.

[0028] The printer head is arranged so that the nozzle 14a of the ink discharge part 10A may counter via a prescribed interval from the print surface of the body for a print. And liquid ink is guided into the liquid ink room 13a via an ink passage from an ink tank, and liquid ink is heated by the heater 11A or 11B in this liquid ink room 13a. An ink drop is made to breathe out from the nozzle 14a by the energy at the time of this heating, and ink drop D is made to reach the body for a print.

[0029] According to this embodiment, the ink discharge part 10A forms the two heaters 11A and 11B to the one nozzle 14a. $L1_A$ and $L1_B$ show the center line of each heaters 11A and 11B, respectively. The heaters 11A and 11B are arranged to the displacement direction of the body for a print in a printer in abbreviated rectangular directions. The heaters 11A and 11B are arranged so that it may become axial symmetry to the center line $L2$ of the nozzle 14a.

[0030] arranging each heaters 11A and 11B like this embodiment -- center line $L1_A$ and $L1_B$ of each heaters 11A and 11B -- ** from the center line $L2$ of the nozzle 14a -- it will shift in fixed quantity.

[0031] Next, the drive method of the heaters 11A and 11B of a printer head is explained.

(A 1st embodiment of the drive method of a printer head) Each heaters 11A and 11B comprise a 1st embodiment so that it can drive individually (independently). That is, only the heater 11A can be driven, ink drop D can be made to breathe out, and only the heater 11B can be driven and ink drop D can also be made to breathe out. The actuator (not shown) which enabled it to drive these independently is

electrically connected to the heaters 11A and 11B, and the drive of the heaters 11A and 11B is controlled by the actuator.

[0032]When only the heater 11A is driven and the ink drop D1 is made to breathe out, since the ink drop D1 prescribed-angle-degree-shifts and is breathed out to the center line L2 of the nozzle 14a, it reaches the position which shifted to right-hand side among drawing 1. When only the heater 11B is driven and the ink drop D2 is made similarly to breathe out, since the ink drop D2 prescribed-angle-degree-shifts and is breathed out to the center line L2 of the nozzle 14a, it reaches the position which shifted to left-hand side among drawing 1.

[0033]When carrying out a print to one line of the body for a print, one of the heaters 11A or 11B is driven, and the ink drop D1 or D2 is made to reach the body for a print in this embodiment. And only prescribed distance displaces the body for a print, one of other heaters 11B or 11A is driven, and the ink drop D2 or D1 is made to reach the body for a print in the following one line. This method is repeated by turns. The ink discharge part 10A drives the heater 11A first, and makes the ink drop D1 reach the target in drawing 1. The body for a print of one line is displaced, next drive the heater 11B, the ink drop D2 is made to reach the target, the body for a print of one line is displaced further, and the example which drove the heater 11A next and the ink drop D1 was made to reach is shown.

[0034]Drawing 2 (a) - (c) is a figure showing the example at the time of making the ink drops D1 and D2 reach the body for a print as mentioned above, respectively, and recording a picture. In drawing 2, the longitudinal direction in a figure is the side-by-side installation direction of the ink discharge part 10A, and figure Nakagami down is a displacement direction of the body for a print. Drawing 2 shows the six ink drops D1 or D2 to one line.

[0035]It is shown among a figure that the numerals of "A" shown in the left end of each line and "B" drove the heaters 11A and 11B, respectively, and made the ink drop reach the target. That is, the line which attached the numerals of "A" is the ink drop D1, and the line which attached the numerals of "B" is the ink drop D2.

[0036]In the example of drawing 2, it counted from the left among the six ink drops D1 at one line, or the impact position of D2, and the 1st, the 3rd, and the 6th thing have reached the target position. moreover -- counting from the left -- the 2nd and the 5th ink drop D1, or D2 -- a target position -- the inside of a figure, and right-hand side -- ** -- it is shifted in fixed quantity. moreover -- counting from the left -- the 4th ink drop D1 or D2 -- a target position -- the inside of a figure, and left-hand side -- ** -- it is shifted in fixed quantity.

[0037]In this case, when the impact position gap by one line arises over all the lines, it becomes being the same as that of the example shown by drawing 7, and a stripe comes to be conspicuous. However, in this embodiment, the heater 11A or 11B was made to drive by turns for every line, and the ink drop D1 or the impact position of D2 is shifted equally to right and left for every line. The stripe generated in line form stops thereby, being conspicuous in the displacement direction of the body for a print, as shown in drawing 2.

[0038]It is made for drawing 2 (a), (b), and (c) to differ in the ink drop D1 with the heaters 11A and 11B, or the impact position of D2, respectively. Drawing 2 (b) enlarges quantity which an impact position shifts from drawing 2 (a), and drawing 2 (c) enlarges further quantity which an impact position shifts from drawing 2 (b). That impact position gap stops being conspicuous understands as quantity which an impact position shifts is enlarged.

[0039](A 2nd embodiment of the drive method of a printer head) Drawing 3 (a) - (c) is a sectional view which illustrates a 2nd embodiment of the drive method of the heaters 11A and 11B of a printer head, respectively. The heaters 11A and 11B are driven simultaneously, and ink drop D is made to breathe out in a 2nd embodiment. In drawing 3, driving force of P_A and the heater 11B is made into P_B for the driving force of the heater 11A.

[0040]First, drawing 3 (a) is an example when it is considered as $P_A > P_B$. In the liquid ink room 13a, among a figure, since the driving force of the heater 11A arranged on left-hand side is larger, among a figure, ink drop D shifts rightward and is breathed out. On the other hand, drawing 3 (b) is an example when it is considered as $P_A < P_B$. In the liquid ink room 13a, among a figure, since the driving force of the heater 11B arranged on right-hand side is larger, among a figure, ink drop D shifts leftward and is breathed out.

[0041]As mentioned above, by setting driving force P_A and P_B of the heaters 11A and 11B as a predetermined value, although it is clear, ink drop D can adjust so that it may be breathed out in parallel with the center line L2 of the nozzle 14a.

[0042]Drawing 3 (c) is an example when it is considered as $P_A = P_B$. If ink drop D is breathed out in parallel with the center line L2 of the nozzle 14a in this driving force, it is not necessary to change the driving force of driving force P_A of the heaters 11A and 11B, and P_B . If it seems that ink drop D shifts to left-hand side, and is breathed out among a figure in this case, driving force P_A of the heater 11A by however, the thing made larger than driving force P_B of the heater 11B. It becomes possible to make the orbit of ink drop D breathed out into the center line L2 of the nozzle 14a in parallel.

[0043]Similarly, if it seems that ink drop D shifts to right-hand side, and is breathed out among a figure, it will become possible to make the orbit of ink drop D breathed out into the center line L2 of the nozzle 14a in parallel by making driving force P_B of the heater 11B larger than driving force P_A of the heater 11A.

[0044](Other embodiments of the ink discharge part of a printer head, and a 3rd embodiment of the drive method of a printer head) Drawing 4 is a sectional view which shows other embodiments of the ink discharge part of the printer head by this invention, and illustrates a 3rd embodiment of the drive method of the heater of a printer head. Unlike the ink discharge part 10A of drawing 1, ink discharge part 10A' of drawing 4 is provided with the three heaters 11A, 11B, and 11C.

[0045]In drawing 4, each heaters 11A, 11B, and 11C are arranged to the displacement direction of the body for a print in a printer in abbreviated rectangular directions. The heaters 11A and 11B are arranged so that it may become axial symmetry to the center line L2 of the nozzle 14a. This arrangement is the same as that of the embodiment of drawing 1. The heater 11C is arranged so that the center line L1_C may be in agreement on the center line L2 of the nozzle 14a, and a design.

[0046]Ink drop D is made to breathe out without making only the heater 11C drive and driving the heaters 11A and 11B in principle, and the body for a print is made to reach the target in this embodiment. However, it is performed as follows, when the orbit of breathed-out ink drop D is not in agreement with the center line L2 of the nozzle 14a and ink drop D does not reach the target within the

limits of a target position by the installation error of the heater 11C, etc.

[0047]First, the heaters 11A and 11B are made to drive by turns for every line as the 1st drive method, as the embodiment of drawing 1 showed. The heater 11C is not driven at this time. Thereby, the same effect as the embodiment of drawing 1 is acquired.

[0048]Driving force P_A of the heater 11A and driving force P_B of the heater 11B are changed, and ink drop D is made to breathe out as the 2nd drive method, as the embodiment of drawing 3 showed. The ink droplet liquid D can be made to reach the target position of the body for a print by adjusting the balance of this driving force P_A and P_B . Further in this case, driving force P_A and P_B of the heaters 11A and 11B may be adjusted, and an impact position may be adjusted without driving the heater 11C. On the other hand, the heater 11C is also driven simultaneously and an impact position may be adjusted.

[0049]As mentioned above, although one embodiment of this invention was described, following various modification is possible for this invention, without being limited to the embodiment mentioned above.

(1) In this embodiment, when it had the two heaters 11A and 11B, the case where it had the three heaters 11A, 11B, and 11C was mentioned as the example, but four or more may be arranged, without being restricted to these.

[0050](2) When arranging the two heaters 11A and 11B, as the embodiment showed, it may not be axial symmetry to the center line L2 of the nozzle 14a. That is, the axis of symmetry with the two heaters 11A and 11B may shift to the center line L2 of the nozzle 14a. When arranging three or more heaters, it is not necessary to arrange the heater of a couple symmetrically to the center line L2 of the nozzle 14a similarly.

[0051](3) When forming three or more heaters, it is not restricted to the drive method of the heater of the printer head shown by this embodiment. For example, three or more heaters are arranged to abbreviated rectangular directions to the displacement direction of the body for a print, the heater driven for every line is changed, and it may be made to make an ink drop breathe out. For example, with the first line, drive only the heater 11A, and ink drop D is made to breathe out in ink discharge part 10A' shown by drawing 4, Drive only the heater 11C and ink drop D is made to breathe out, only the heater 11B can be driven and ink drop D can also be made to breathe out further in a succeeding line in a succeeding line.

[0052]

[Effect of the Invention]According to this invention, individually to one nozzle two or more heaters which can be driven, The impact position to the body for a print of an ink drop is changeable by providing in a different position of the liquid ink interior of a room corresponding to one nozzle, changing the heater which should be driven for every line, or changing driving force of two or more heaters etc. It becomes possible to make not conspicuous impact position gap peculiar to a nozzle by this.

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CLAIMS

[Claim(s)]

[Claim 1]In a printer head used with a printer which drives a heater, makes an ink drop breathe out from a nozzle, makes an ink drop reach the body for a print relatively displaced to said nozzle, and records a picture, A printer head forming individually said heater of plurality which can be driven to said one nozzle in a different position of the liquid ink interior of a room corresponding to said one nozzle.

[Claim 2]A printer head installing said two or more nozzles in approximately linear shape side by side in the printer head according to claim 1.

[Claim 3]A printer provided with the printer head according to claim 1.

[Claim 4]A printer, wherein said at least two heaters are installed in abbreviated rectangular directions side by side to a displacement direction of the body for a print among said two or more heaters in the printer according to claim 3.

[Claim 5]While driving 1 or the 1st two or more heaters among said two or more heaters which are the drive methods of a printer head used with the printer according to claim 3, and were formed corresponding to said one nozzle and making an ink drop breathe out, A drive method of a printer head driving different 1 or the 2nd two or more heaters from said 1st heater, and making an ink drop breathe out after displacement of prescribed distance of the body for a print.

[Claim 6]So that it may be a drive method of a printer head used with the printer according to claim 3 and driving force of said heater of any 1 and said heater of other 1 may differ among said two or more heaters formed in said one nozzle, A drive method of a printer head driving said two or more heaters simultaneously.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is a sectional view showing one embodiment of the ink discharge part of the printer head by this invention.

[Drawing 2] (a) - (c) is a figure showing the example at the time of making an ink drop reach the body for a print, and recording a picture, respectively.

[Drawing 3] (a) - (c) is a sectional view which illustrates a 2nd embodiment of the drive method of the heater of a printer head, respectively.

[Drawing 4] It is a sectional view which shows other embodiments of the ink discharge part of the printer head by this invention, and illustrates a 3rd embodiment of the drive method of the heater of a printer head.

[Drawing 5] It is a sectional view showing an example of the ink discharge part of the conventional thermal head.

[Drawing 6] (a) And (b) is a figure explaining impact position gap of the ink drop by gap with the center line of a heater and the center line of a nozzle.

[Drawing 7] It is a figure showing an example which carried out the print using the line head.

[Description of Notations]

10, 10A, a 10A' ink discharge part

11, 11A, 11B, and 11C Heater

12 Silicon substrate

13 Resin film

13a Liquid ink room

14 Resin sheet

14a Nozzle

D, D1, D2 ink drop

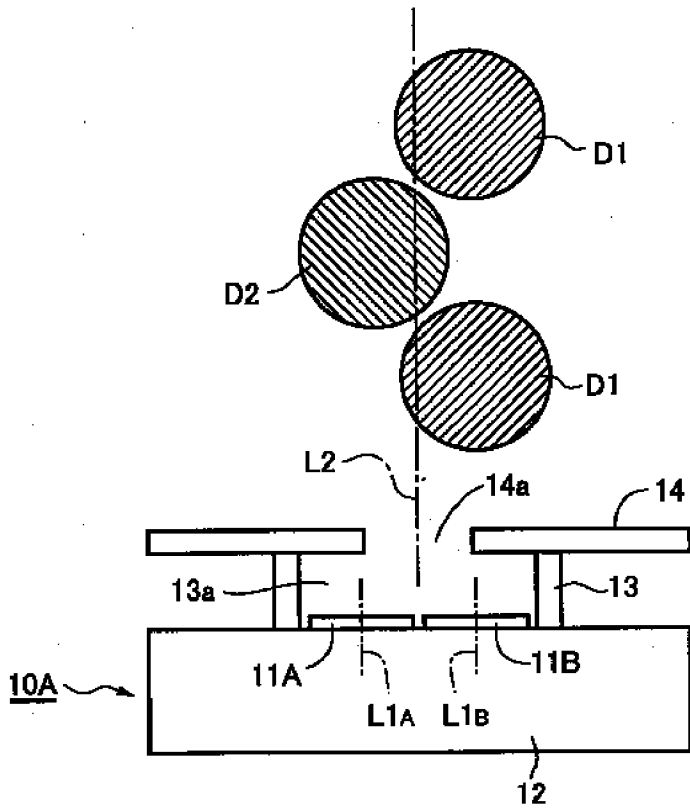
The center line of L1, L1_A, L1_B, and the L1_C heaters 11, 11A, 11B, and 11C

L2 The center line of the nozzle 14a

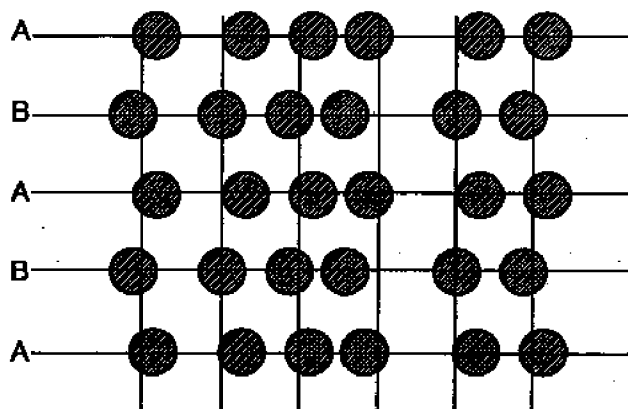
X (L1 and L2) The amount of gaps

theta Angle gap

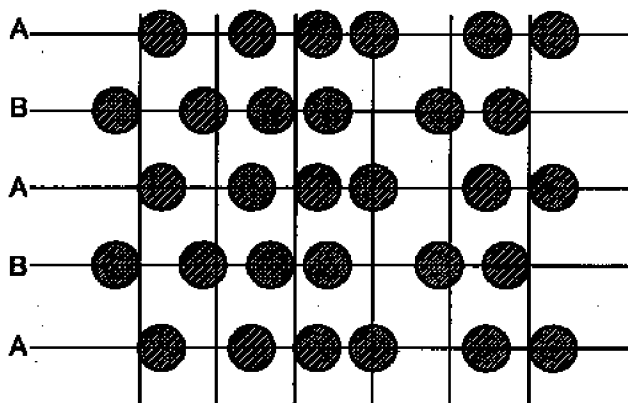
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[Drawing 1][Drawing 2]

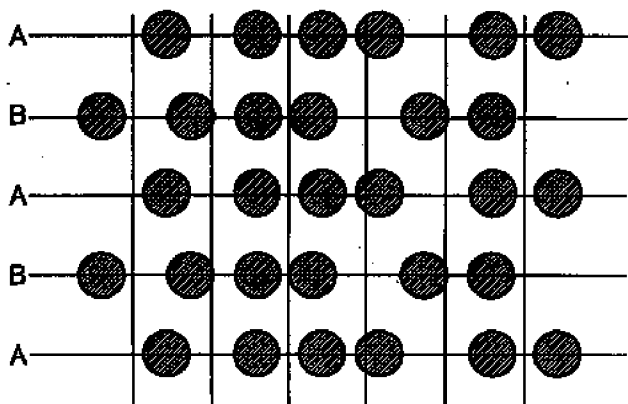
(a)

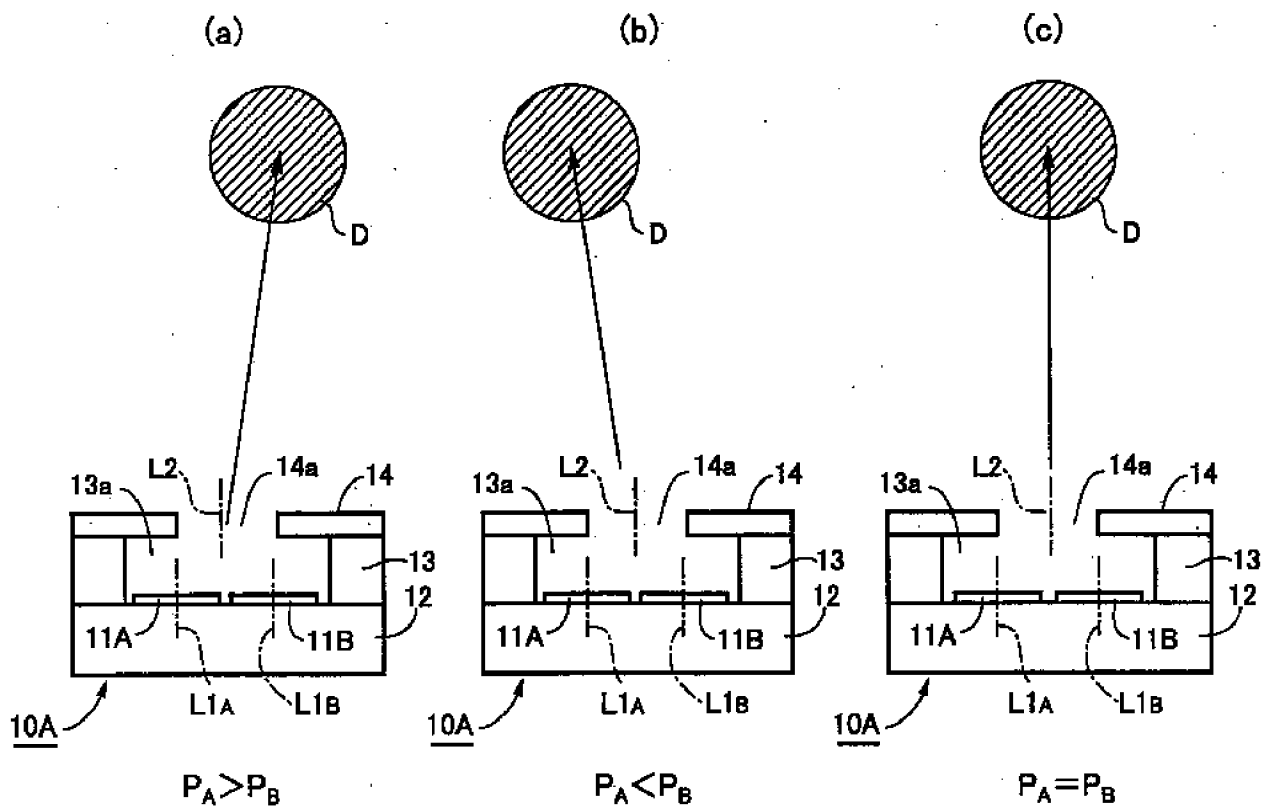


(b)

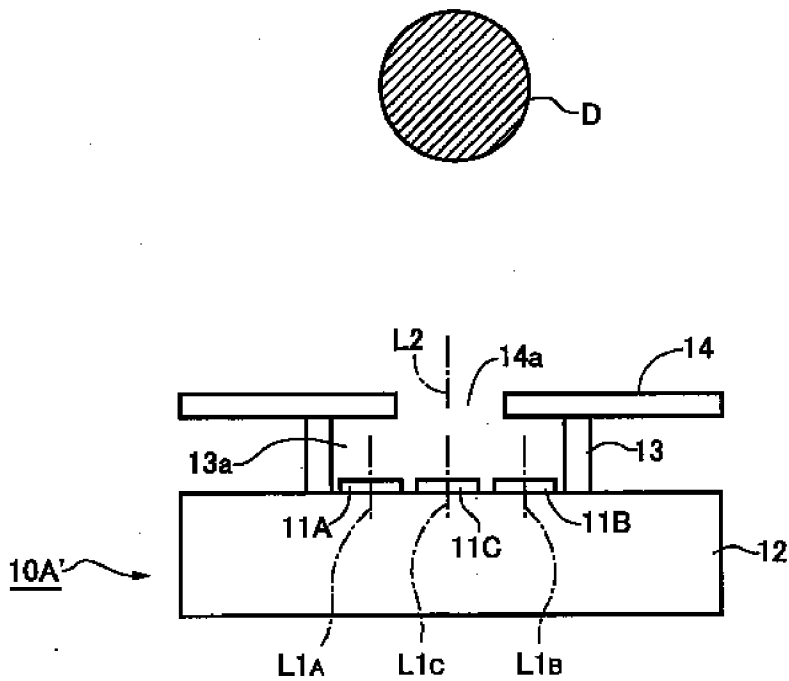


(c)

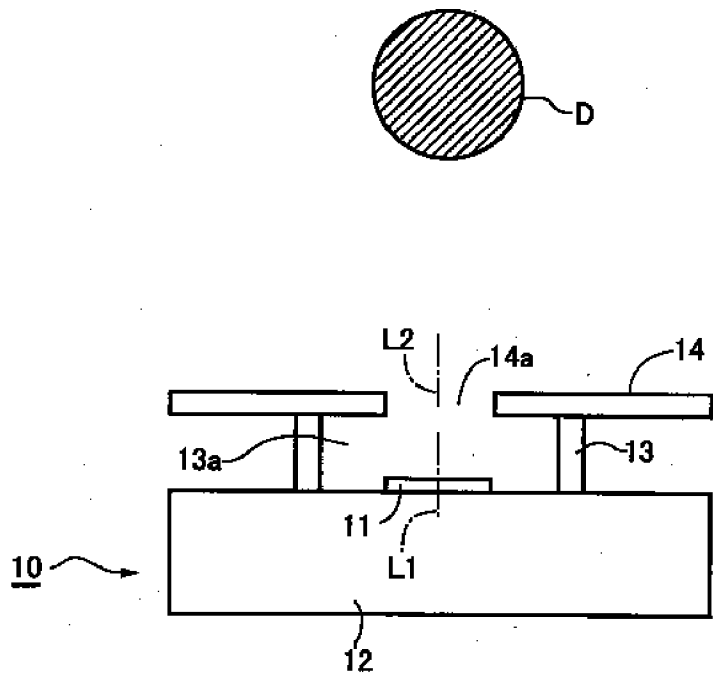
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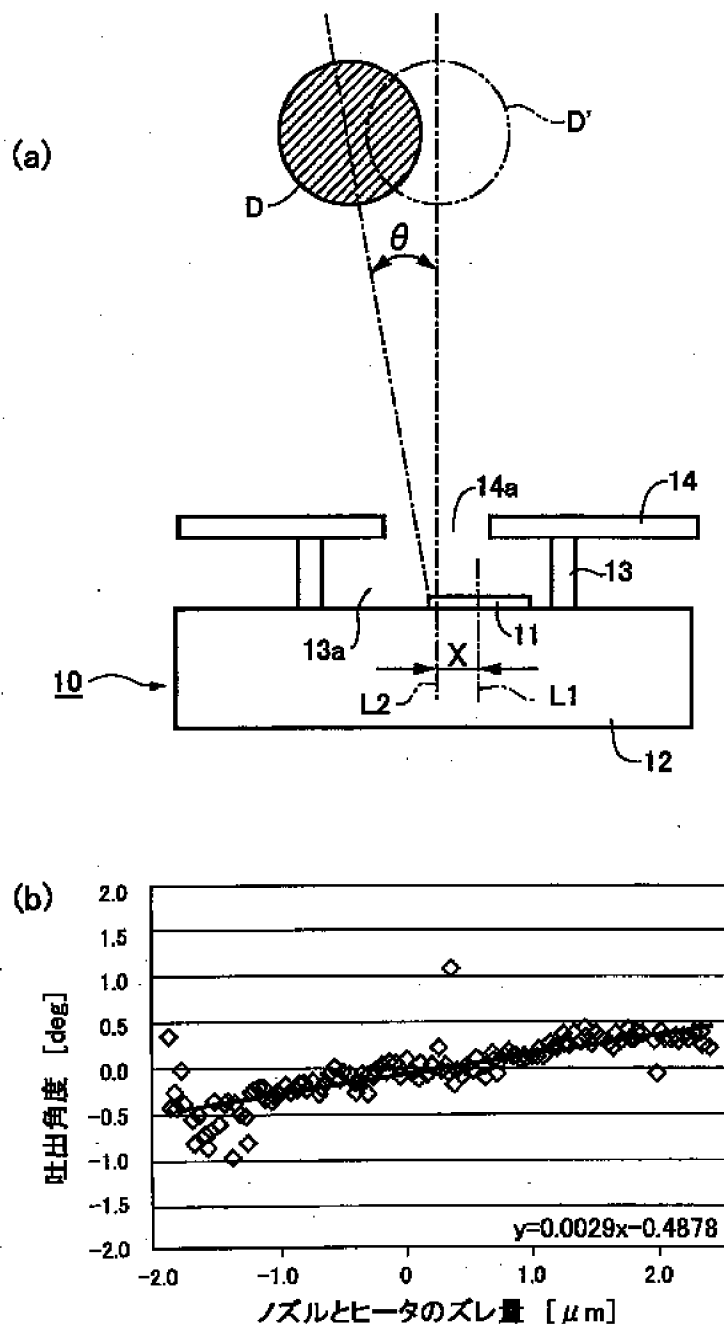
[Drawing 4]



[Drawing 5]



[Drawing 6]



[Drawing 7]

